TUBE COLLECTOR

TUBE COLLECTORS ASSOCIATION

"HISTORY • PRESERVATION • APPLICATION"

Vol. 21 No.1 February, 2019

TUBE COLLECTOR

TUBE COLLECTORS ASSOCIATION, INC.

PO Box 636, Ashland, OR 97520, USA

The Tube Collectors Association is a nonprofit, noncommercial group of individuals active in the history, preservation, and use of electron-tube technology. *Tube Collector*, its bulletin, appears six times per year.

Officers and Staff

President: Ludwell Sibley, KB2EVN, (541) 855-5207, *tubelore@jeffnet.org*
Vice President: Jim Cross, (407) 816-8495, *jim@vacuumtubesinc.com*
Secretary-Treasurer: Bob Deuel, K2GLO, (541) 482-8752, *k2glo@jkasystems.com*
Editor: Ludwell Sibley, as above
Webmaster: Norm Wilson, N6JV, (916) 689-3534, *N6JV@N6JV.com*
Awards Administrator: Frank Hagenbuch
Directors:

John Atwood	Al Klase, N3FRQ
Kirk Cline	Joe Knight (chairman)
Jim Cross	Norm Wilson, N6JV

Honorary Members: Bob Deuel, K2GLO; Al Jones, ex-W1ITX; Hisashi Ohtsuka; Ludwell Sibley, KB2EVN

Web Site: *www.tubecollectors.org* (includes an index to all TCA pubs).

email Reflector: *tubecollectorsassociation@yahoogroups.com*
To subscribe: send a blank, untitled email to
tubecollectorsassociation-subscribe@yahoogroups.com
To unsubscribe: send a blank, untitled email to
tubecollectorsassociation-unsubscribe@yahoogroups.com
Group moderator: Ron Lawrence, W4RON, *w4ron@carolina.rr.com*

To join TCA: annual dues is $20.00 in North America; $25.00 elsewhere. Payment by PayPal is welcomed, to *tca@jkasystems.com*. If using a check or MO, please make it payable to "Tube Collectors Association" and mail to the PO box above. The membership year runs January-through-December. Those joining after February receive the current year's back issues of TCA publications. Multi-year membership is invited, at, in North America, $37 for two years or $54 for three; elsewhere, $49 for two years or $73 for three.

Inquiries, changes of address, and other membership business should go to Bob Deuel at *k2glo@jkasystems.com* or at the PO box above. Please use these addresses for inquiries or correspondence. The *"tca"* email address above is purely for PayPal use and is not monitored or used for general purposes. Please use it for payments, not Deuel's personal account, and avoid using the "Friends and Family" option.

Articles on tube topics are welcomed. Editorial correspondence should go to the editor at *tubelore@jeffnet.org* or 102 McDonough Rd., Gold Hill, OR 97525. **Please send text and graphics as separate files.**

Unless copyrighted by an author, this material is available for **attributed** reproduction.

FRONT COVER: A British playing card promoting the Mazda brand. The image is remarkably similar to the RCA "Selling Fool".store-display mannequin of 1931-32, seen on the October 2013 cover. It differs only in tiny details. Or, take a close look at the rear cover of last December's issue: there he is again! *Image: Tim Laing, posted lately on the TCA email reflector.*

REAR COVER: A rather persuasive recruiting poster, apparently put out just after the very word "Radar" was no longer classified. The enlistee was to learn klystrons, magnetrons, CRTs, and similar high-tech material, with good pay. *Image: Larry Daniel*

MICROPHONICS FROM THE EDITOR

MEETING AND AUCTION: MAY 11

An auction is planned for Saturday, May 11 of a considerable collection of tubes, books, and antique radios held by the Association. It will be at the Old Sams Valley school outside Gold Hill, Oregon. The site, of previous meetings, is about 40 miles north of California and about 7.5 miles off Interstate 5.

A starter list of the material is on Page 2. A full catalog is planned, to go out with the April *TC*.

TCA BACK ISSUES - CURRENT STOCK

A good many "year packs" of back issues are still available. At least four are on hand for 2001 through 2006 and 2010 through 2018. Most include a Special Publication (two of them with 2010). "2014" features W. C. White's never-published history of electronics development at GE, 1914-54. It's 72 pages in 8-½" x 11" format. (The manuscript was a severalth-generation xerocopy provided by Attila Balaton, copied from the library of French tube professional and collector Robert Champeix.) "2018" includes Danial Stocks' revelation of the once-classified Carcinotron electronic-warfare tube, 65 pages, also 8-½" x 11".

The index to all of these is on the TCA Web site. The price is unchanged: $18 per year in North America, $23 elsewhere. A 15% discount applies if two or more years are purchased. Mailing is postpaid - "free shipping"!

The stockboy at tubelore@jeffnet.org will continue to handle questions about availability.

IN THIS ISSUE

New Television Protection Feature
RCA Victor *Radio-Phono-TV Tips* 2
The Radio Repairman
Consumer Reports 3
Electrolysis in 1B3GTs
Philco Serviceman 6
Stanley Electronics Joins the Tube Crushing Program
Popular Electronics 8
Weird Tube of the Month
National Union Anodyne
Danial Stocks 9
New Family of G-E Full-Wave Rectifier Types Now Available
GE Techni-Talk 11
"Whippany"
*RCA Victor "Plain Talk"*y 12
FM Barrage Jamming - An Idea Before Its Time
Danial Stocks 13
Application Note - Triode Operation of 42 and 2A5
RCA AN-35 15
Triad Metal Shielded Radio Tubes
RMA Release 34 20
Notes on the Use of the Ultraudion
Leonard Fuller 23
Locating Gassy Tubes
Philco Serviceman 27
A Simple Catechism on Tube Checkers
RCA 33

START-UP LIST OF AUCTION CONTENTS

TUBES

Arcturus blues (13)
Cunningham Audiotron
DeForest DV-DL types (4)
DeForest spherical Ultraaudion
Disc-TV neon lamp
Eimac "Tieode" tie clip
Eimac's first tubes (150T, 50T)
Eimacs, other (15)
Kellogg AC types (3)
Marcus Thielen 2005 Audion replica
QRS types (3)
Rogers "metal-spray" types (6)
Schickerling S-2500 in box
Small CRTs (6), including 3NP4
WD-11s (3)
WE "tennis balls" (6)

Boxed big-pin types (ca. 60)
Early light bulbs
The big-pin types have AES holder rings.

RADIOs AND PHONOs

Aeriola Jr. crystal set
Aeriola Senior one-tuber
Atwater Kent 10 breadboard
Atwater Kent 30
Atwater Kent 33
Crosley 52
Edison Gem cylindrical photo
Fada 160
Fada 195 Neutrodyne
Freed-Eisemann NR5
Kennedy 281
Radiola 33
Radiola III and IIIA
Regenerative 3-tuber
Stromberg-Carlson 1A Neutrodyne
Victor VV-50 portable phono
Westinghouse RA-DA

LITERATURE

Canadian tube manuals
AWA Review old-timers
CHRS, AWA, and other periodicals, in multi-year sets
Radio College of Canada binder on '30s sets
Phonograph books
Gernsback Official Radio Service Manuals, 1930 and 1932
Rider's Perpetual Radio Troubleshooter's Manual (early issue pre-Vol. 1)
Others, to be listed in catalog

OTHER

Glass-and-oak antique display cabinet
Wedding-cake display fixtures (2)

NEW TELEVISION PROTECTION FEATURE

RCA Victor Radio-Phono-TV Tips, *April 1, 1950.*

Consider the scene: it's 1950, and Mr. Proudview has just had a TV set installed. At 14 inches, it's the biggest one in the neighborhood. So he invites the neighbors over to watch "I Love Lucy."

Then, one evening out in the yard, he notices a fiery orangish glow coming from the lightning protector where the Twin-lead from the antenna goes into the wall. Mystified by this phantasm, he calls the TV shop. The repair tech advises him to "turn the plug over." He does so, and the apparition disappears. - Ed.

Underwriters' Laboratories have insisted that additional protection be provided in television receivers by adding a 100,000 ohm resistor from one side of the 110 volt ac line to the chassis. This will parallel one of the .01 mfd capacitors presently connected from each side of the ac line to the chassis.

On installations incorporating the neon lamp type lightning arrestor, the addition of this resistor may be sufficient to cause one of the neon lamps to glow. Of course, this would result in a loss of signal. If this occurs, it is merely necessary to reverse the power plug. The customer should be so instructed in order to avoid replacement of the line plug in its incorrect position.

THE RADIO REPAIRMAN

... won't be so likely to gyp you if you know what you can fix yourself, what you have to let him fix, and how to check up on him. CU makes a few suggestions.

Consu*mers Union Reports*, Technical Section, October, 1941

THE RADIO repair man will gyp you if you don't watch out. That's the title and that's the essence of an article in the August issue of *Reader's Digest*, wherein the experiences of two roaming investigators in 304 of the nation's radio shops were described.

Into each shop the investigators took a radio which "a few minutes before . . . had been playing perfectly, but which was deliberately put out of order by the investigators, sometimes by disconnecting a snap-on wire, usually by loosening a tube."

61% of all the shops visited, and 90% of the shops in large cities, tried to take advantage of the investigators' supposed ignorance, either by charging for unneeded or unperformed services or by replacing undamaged parts. "The first 36 shops visited . . . sold the investigators 32 new tubes. Not one was needed."

In one case, after the investigators had been sold a new tube and had demanded their old tube back, the service man "went to the shelves stocked with cartons of new tubes, and . . . took . . .our tube [which] . . . he had simply added . . . to his own stock."

Persons familiar with the operation and servicing of radios have been aware of the frauds involved in radio repairing for some time; the general public has only suspected them. Now that the facts are out, various radio service magazines are busily offering apologies, on one hand, and inventing flaws in the investigators' methods, on the other.

Consumers need have no doubts, however, that the facts and implications of the *Reader's Digest* article are substantially correct. The investigators seem justified in concluding that you run most chance of getting gypped in large cities, and are most likely to get a fair deal in small towns where the service man must be more careful of his reputation.

The answer to the question: "Why is there so much deception and gypping in radio repairing?" is certainly, in part, that there are many too many service men for the market to support. Requirements for going into the business are simple: more or less knowledge of radios and a table to work on. The results: a terrific surplus of service men — both bona fide and tinkerers — and almost an economic compulsion for repair men to overcharge on each job. Moreover, a customer will often consider that after having his set fixed once, he is entitled to free repairs if anything else goes wrong. Thus the repairman overcharges partly to cover such nuisance service calls.

CHECK IT YOURSELF

WHAT can the consumer do about this state of affairs? CU in this report takes up where *Reader's Digest* leaves off, with some advice to help the consumer keep his radio repair costs down.

Although people can't become radio repair experts by reading an article, they can learn to look for and recognize a few basic disorders, which are responsible for much faulty radio performance. They then may be able to avoid taking their radio to a service man who may charge for repairs that weren't necessary.

Defective aerials are common causes of radio trouble. If your radio has a bad, irregular crackle, disconnect the antenna and ground from the radio; then, with a short piece of wire, connect together the aerial and ground posts (or connect the aerial connection to the chassis if there is no ground post) and turn up the volume control. If the crackle has disappeared, the fault probably lies in the aerial. Inspect your aerial to make sure that it is not touching metal objects or other aerials. If your aerial is not all one piece of wire,

make sure that the joints aren't loose. (And if you are installing a new aerial, make it all one piece from the radio to the extreme far end.) If your aerial is all right, look at other aerials, or hanging pieces of wire, and make sure they are not rubbing against each other or against metal objects. They can affect your radio even if they are in no way connected with it. Look also for loose connections on nearby appliances or lamps.

If your radio becomes generally insensitive, so that only strong stations can be heard, connect a piece of wire at least five feet long to the aerial post of the radio. If the reception becomes louder, the aerial wire is improperly connected or broken somewhere near the radio. In cities satisfactory reception can often be obtained without any aerial at all (not even a loop antenna), if a wire is connected from the aerial post of the radio to the steam or water pipe.

In some, though very few, cases of noisy radios, you may be able to eliminate the noise by connecting a wire from a water or steam pipe to the ground post of the radio. The ground post as often as not will be a black wire some six inches long sticking out at the back of the radio. It's a good idea to have a ground connection anyway — if a ground post or wire is provided — because it will reduce the shock hazard in some radios.

Hum in a radio operating on a-c can often be eliminated or reduced by reversing the electric plug in the wall socket, or by moving away any appliance or lamp that is standing too close to the radio.

Don't patronize street vendors selling filters or "static eliminators." (The equipment they use for demonstration is a fake.) Usually, though not always, the only effective static filters are those applied at the source of the static — on the motors, lights or electrical appliances which cause "man-made" static.

Many radios operating erratically — with minor evidence of intermittent reception — will often respond to a hard whack on the cabinet and come back to life temporarily. In many instances a service man is not required to effect a permanent repair. All tubes should be wiggled in their sockets, grid caps twisted, shield tops twisted back and forth, and finally shield cans rotated a bit.

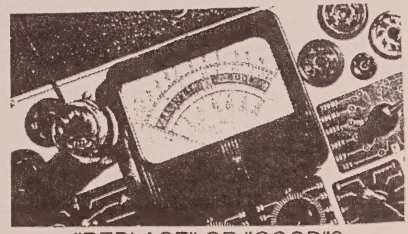
This same procedure will, more often than not, cure a radio set of its squeals.

If your radio shows absolutely no signs of life — no light, no sound, no heat — there still may be nothing wrong that a little attention won't correct.

Check the electric plug; see whether the "legs" and the wires leading to the legs are intact and make sure that it's inserted completely and firmly into the socket. If it is, test the socket — see whether a lamp that is plugged into it will light.

You may find that an ac-dc radio operating on d-c will heat up but won't play because the plug is inserted into the socket the wrong way. Just reverse the plug.

If you have an a-c radio and have moved to a d-c location, don't have it converted into a d-c radio. The job is very apt to be unsatisfactory, and if you move again you will probably have to have it done all over (there are relatively few d-c areas in U. S. cities). Either buy an ac-dc midget for temporary use while at the d-c location or else buy a d-c to a-c inverter, costing about $18 at Lafayette and Allied.



"REPLACE" OR "GOOD"?
The tube testing machine tells —
if the salesman lets it.

TRY THE TUBES

IF YOU still get no sound from your radio, then you may begin to suspect a burnt-out tube. And the chances are pretty

good that the trouble is just that, for defective tubes are responsible for much radio trouble. Again, don't throw up your hands and send for the service man. If he replaces any tubes, he's likely to charge you the full list price, plus a service fee.

You can do the job much more cheaply if you'll remove the tubes yourself and take them to a radio store to be tested. Pick out a store which gives at least a 40% discount on standard brands of tubes. Your best bet will probably be either a local store of a mail order house or a large chain radio supply store. They may sell their own private brands (Knight, Lafayette, Sears', Ward's) at even lower prices.

This way you'll not only save money on the tubes, but avoid the possibility of paying the service man for non-existent defects in your radio.

Removing tubes is a comparatively simple operation anyway. But remember one thing: always pull out the electric plug from the wall socket before touching the tubes — or, in fact, before venturing inside the cabinet of the radio for any reason. The inner mechanism of some radios is a potent source of shock.

If there is a wire running to the top of some of the tubes in your radio, pull off the cap to which the wire is soldered, using a pencil to pry it up if necessary. Tubes with form-fitting metal shields around them can be removed in entirety, and the shields slipped off afterwards. Shields like round cans must be removed before the tube is taken out. To remove a tube easily, grasp it firmly and use a straight, upward pull combined with a rocking motion.

Notice whether the tube's type number (such as 6SK7 or 6V6G) is printed near the socket. If it isn't, write in the number as you remove the tube, so that you'll have no difficulty in returning the right tube to each socket. If there are duplicates, mark each tube and socket.

When a salesman tests your tubes and tells you that you need a certain number of replacements, you may as well just take his word for it, and buy the tubes. What the tube testing machine shows is neither here nor there, because it can be made to register anything a dishonest salesman wants it to register. Be sure to keep your old tubes. A tube that tests "bad" in a tube tester may work in your own particular radio.

When you get home, put your old tubes back in the set, note the radio's performance and then substitute the tubes you've bought one by one. If the new tube makes the radio work better, use it, and throw its old counterpart away. But where there's no noticeable improvement, leave the old tube in.

Thus you may end up with some extra tubes on your hands, which might come in handy for a future emergency. If you're not interested in that, you can order a complete set of tubes from Sears-Roebuck or Montgomery Ward and within 15 days return any or all tubes that don't improve your radio. This offer is made by both Sears and Ward's in their catalogs.

Finally, remember that whether your tubes were bought or tested within a year or a week, they can go bad at any time. Tubes don't need to be replaced regularly, but only when they stop functioning normally.

With some types of ac-dc radios, you must be careful to replace the pilot light as soon as it burns out, to prevent tubes from burning out, too.

NOW CALL IN THE SERVICE MAN

IF you've checked all the points mentioned here, from the aerial to the tubes, and nothing seems to help the performance of your radio, then you'll have to enlist the aid of a radio repair man. If your radio is small, take it to his shop and try to get him to fix it while you wait. If you leave it with him so that he can go over it later to estimate the charge, he may not only overestimate, but also put other parts out of order so that they will require fixing. If the radio man will fix your set while you wait, you are much more likely to get a correct charge for the time he spent on it and for the parts which you saw

him replace — if any.

If your radio is too large to take to a shop, you'll have to call a service man to your home and expect to pay him for his time. But warn him in advance that you want the work done in your home. Most service men will claim that it's necessary to take it to the shop, and it may be, if the trouble is intermittent. However, radio troubles that can't be both diagnosed and fixed on the spot are rare indeed.

But if the radio is fixed in your home, in your presence, the repairman isn't so apt to charge for servicing which he never performed. He can expect his $2 hourly fee, but no more.

Before the radio is fixed — at home or in the shop — let the service man know you will want the old parts, if you are to be billed for replacements. You may thus avoid being charged for fictitious replacements. And you keep the service man from using old parts from your radio in repair jobs that he does for others.

RECORD CHANGERS

WHEN it comes to repairing record changers, the situation is most hopeless of all. There are very few bona fide specialists, and many radio repairmen are not interested in servicing a mechanical mechanism like a record changer. If you are mechanically inclined or have a friend who is, you may be better off inspecting and adjusting it yourself.

Frequently, record changers operate poorly because the mechanism is not properly leveled. Try propping up one side of the radio (usually the right side facing you). In any case when you buy the radio you should write to the manufacturers of both the radio and the record changer for "service notes" on the record changer.

ELECTROLYSIS IN 1B3GTs

Philco Serviceman, Dec. 1953

Question:

What causes the 80 series to make IB3GT Hi Voltage Rectifiers crack around the cap? I have noticed that this trouble is much more prevalent among Philcos than the other brands I have serviced. Why?

FRED W. TAPPAN
Jackson, Miss.

Answer

During the early part of 1952, certain materials became difficult to obtain due to the Korean situation. Lead was among these items. Lead is a necessary component in the manufacture of certain types of glass. Vacuum tubes use this type glass for their envelopes. The addition of lead to glass permits the glass to exhibit characteristics which are advantageous where it is necessary to extend an element of the tube through the glass envelope, as is done in a 1B3 type tube. The shortage of lead forced tube manufacturers to cut back or stop production, or to produce tubes with lower lead content glass. To meet the tremendous demand for tubes many manufacturers followed the latter course.

The trouble which you had experienced with the glass envelope developing a fracture at the point where the anode cap extrudes *[sic]* through the envelope is a result of "lead free" glass. This problem is no longer present since for the past many months the lead situation has relaxed to the point where lead glass is readily obtainable for manufacturing these tubes. It is possible that parts wholesalers still have some of the 1B3 type tubes with lower lead content glass on their shelves but this stock will soon be exhausted.

THE MARGO DIODE

Collector Len Arzoomanian recently visited the New England Museum of Wireless and Steam in East Greenwich, Rhode Island to continue cataloguing the contents of the Wireless building. He came across an early diode, with carton and instruction sheet. Here's the discovery, as posted on the TCA email reflector.

Tyne's Saga reports that, upon expiration of the Fleming Diode patent in November 1922, detector diodes came on the US market, among them the Electtrad and Margo. The latter originated in Tubesville (Newark) and was sold by Modell's on Fulton Street in New York.

These tubes were gainless and were uncompetitive with regenerative triode circuits. They didn't last long. The Margo company does not appear in the November 1924 *Radio Trade Directory.*

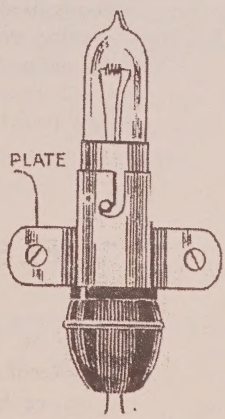
MARGO DETECTOR COMPANY
64 BOYLAN ST., NEWARK, N. J.

The Margo Tube is simply an improved Fleming Valve made stronger, smaller and with a newer and more economical method of basing. It does not take the place of any other tube, but it has its value for experimenters who have not had an opportunity of studying the Fleming Valve.

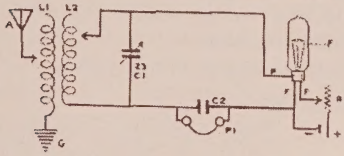
It is also of value to beginners, as it will operate on one dry cell either with or without B Battery. While its functions are limited, it really detects, and no end of interesting experiments can be worked with it. It will not function in every hook up but splendid results have been gotten with circuits similar to those shown.

Its low cost and small consumption of current makes it available to every one.

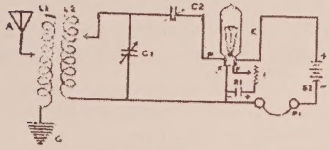
It is offered to the Trade at $1.00 list, but we do not recommend it for any other purpose than described.



HOOK UP WITHOUT B. BATTERY



HOOK UP WITH B. BATTERY

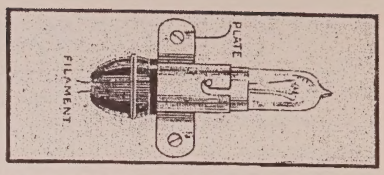


The filament F is lighted by B.I. (1 dry cell) one terminal of the secondary winding L-2 is attached to the base P (plate connection) and the other side to the negative side of F. The a ion of value is as follows:- When an oscillating Electric Motor Force is impressed upon plate and filament, the plate is charged alternately to a positive and negative potential. When plate P. is charged to a positive potential Electrons are drawn over from filament which means that a half cycle flows from plate to filament.

When plate is charged negatively, no electrons are drawn to plate and no current passes the valve. The Condenser C-2 therefore, receives a uni-directional charge over the durations of a wave train and at the end discharges thru telephone P-I. For good results use high resistance 'phones. If your dry cell is weak use two cells in series and Rheostat.

This tube has been used for many years in colleges and laboratories and is now for the first time available to the general trade.

Left: tube base is stamped "Margo / Fleming / Valve / 1 1/2 Volts."
Right: the carton.



MARGO
FLEMING VALVE EFFECT
MARGO DETECTOR CO.
64 BOYLAN STREET

THIS TUBE HAS BEEN THOROUGHLY TESTED TO AVOID ANY DEFECTS IN MATERIAL & WORKMANSHIP

FILAMENT VOLTAGE 1½ - ONLY ONE DRY CELL REQUIRED - OPERATES EITHER WITH OR WITHOUT B BATTERY

STANLEY ELECTRONICS joins the tube crushing program

In line with its policy of providing service and quality to its customers, Stanley Electronics of Passaic, N. J. has entered into an agreement with a crusher to crush and destroy any and all old or obsolete tubes to take them off the market.

For the first time, you can send all your old tubes to one location, Metallic Enterprises, Inc., 113 Mill St., Paterson, N. J. and receive credit dollars for them.

Our crusher will take them all and allow you a 5¢ credit toward each tube you buy.

Broken Tubes - Smashed Tubes - Tubes of any condition are worth 5¢ ea.
Pull them out of your attic. Dig them out of your garden. Crush them before shipping if you want to. Regardless of the shape it's in, any tube is worth money. Any quantity - 1 to a million.

HERE'S HOW IT WORKS . . .

Suppose you send in 100 old, broken or smashed tubes. You will receive 5¢ credit for each tube to be applied toward the purchase of any type you want. . . . DO NOT SEND ANY TUBES TO STANLEY.

STANLEY Electronics Corp., 935 Main Ave., Passaic, N. J., Gregory 1-2498.

From *Popular Electronics*, January, 1957, Courtesy of Jim Chew

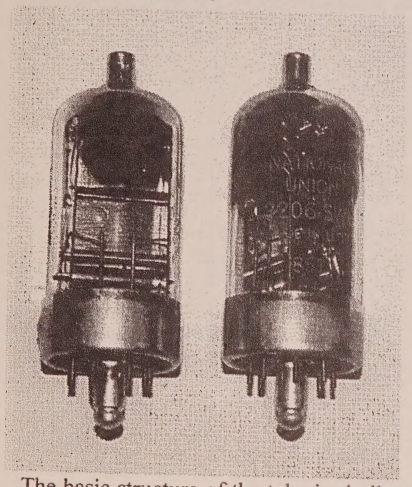
This ad listed about 150 tube types for sale, with brands Admiral, Westinghouse, Motorola, Zenith, Tung-Sol, National Union, Sylvania, and "SE." Prices ranged from $0.39 to $1.18 (1957 dollars). Like most listings of this type, it did not include the 1L6.

WEIRD TUBE OF THE MONTH

NATIONAL UNION ANODYNE

Danial Stocks

The National Union NU-2206-SW6 is an interesting mix of technologies that results in a tube of some unique characteristics. It is a beam-deflection tube with secondary emission operation to boot.



The basic structure of the tube is similar to other types of beam deflection tubes: A long cathode embedded in a simple electron-gun type structure is used to generate a wide, thin fan-shaped electron beam that is projected onto the anode. A pair of deflection plates is used to move the beam laterally across the anode surface. A feature unique to the Anodyne is the structure of the anode: Half the anode is a conventional plate, the other half is composed of a secondary-emissive dynode with an emission coefficient of approximately two. A suppressor mesh placed between the dynode and anode prevents secondary emission from the anode. A mesh collector electrode preceding the combined anode structure serves as an electron accelerator for the main beam in addition to collecting the secondary electrons from the dynode.

It is the special half-secondary-emitter anode structure that gives the tube some unique characteristics. With the beam centred on the anode, half the current will be collected by the normal anode section, the other half will impinge upon the secondary-emission dynode side. With the secondary-emission coefficient of approximately two, the resulting secondary-emission current is roughly equal to the total beam current impinging on the anode. The tube can be calibrated to adjust for variations in emissivity, ensuring a balanced zero point where the two currents exactly cancel.

Thus it can be seen that at the quiescent condition, the sum of beam and secondary emission currents cancel, resulting in zero overall anode current. As the beam is swept to the anode side, a conventional positive current results, and to the other side, the secondary emission exceeds the incoming beam current, resulting in a negative anode current.

This phenomenon gives some unique circuit opportunities. A Class A amplifier with zero quiescent current is possible. Additionally, as the beam current is a constant not defined by the anode conditions, the transconductance and plate resistance are comparatively constant over a large portion of the working region, giving better linearity than conventional gridded tubes.

More complex circuit functions are also greatly enhanced using the tube. As the beam current is controllable via a grid in the electron-gun section, the overall transconductance of the tube may be varied, giving variable-mu operation with very good linearity.

Similarly, by simultaneous input of signals to both the deflectors and grid, balanced modulators may be produced that exceed the performance of conventional tubes in such a circuit. Most significant is that the quiescent condition is one of zero anode current – when driving the beam current to cutoff there is no DC offset condition or loss of linearity that occurs in other variable-mu or modulator circuits.

The tube can also function as a differen-

tial amplifier with very good common-mode rejection. A voltage applied equally to both deflection electrodes does not change the anode current. Different voltages applied to each deflection electrode result in a beam deflection based on the difference of the two signals.

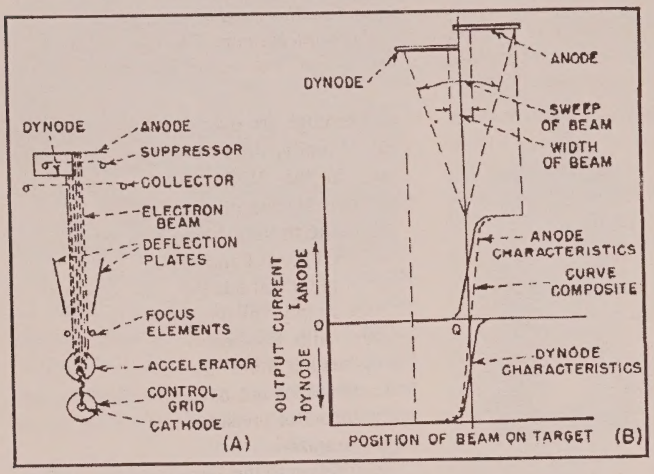


Fig. 1. Internal construction

The combination of anode and dynode used to generate the output suggested the name "Anodyne" to describe the tube. The NU-2206-SW6 is the only type to have been seen, but there were apparently earlier versions leading up to the development of this type (SW1-5). The tube itself is built on a conventional Loctal base with top cap.

Despite the seemingly useful applications, the tube does not appear to have been produced in any quantity and is generally rare. There may have been limiting factors such as decay of the secondary-emission material or difficulties in manufacture. Anecdotal information on the Internet suggests that no more than 50 or 100 pieces of the tube may have been made.

REFERENCES

Anode-Dynode Beam Deflection Amplifier., Wolkstein, H. J.; Kaiser, A. W., *Electronics*., Aug 1955, p. 132-136.

https://www.radiomuseum.org/forum/anodyne_anodyne2.html#1

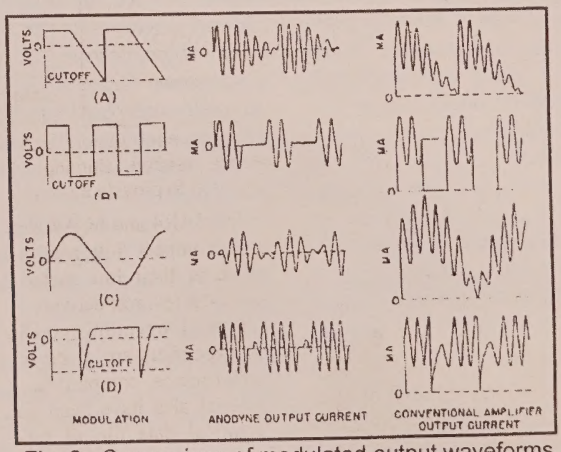


Fig. 2. Comparison of modulated output waveforms for the Anodyne tube vs. conventional tube modulator

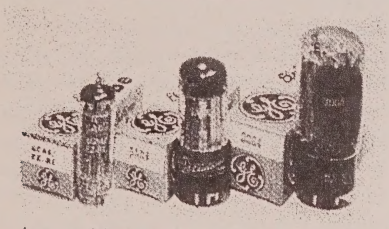
NEW FAMILY OF G-E FULL-WAVE RECTIFIER TYPES NOW AVAILABLE

GE Techni-Talk, *June-July 1960.*

That 3DG4 is an odd one, on close examination. The two filament-oids are vertical bits of tubing, strapped together at the top of the mount. RCA originally bought this type in for the renewal market, then started manufacture, with cathodes purchased from GE. It was a button-stem type, extracting a bit of heat through the pins. The pinout was weird: filament on Pins 1 and 3, plates on 5 and 7.

RCA's 5AR4 (GZ34) was bought-in, presumably for the renewal business. The 6CA4/ (EZ81) is familiar from '60s stereo amps, although Sylvania claimed it was "engineered for damper service in receiver horizontal deflection circuits."

New tube technologies and materials have been combined by General Electric Receiving Tube engineers in three new rectifier tube types which are more efficient than previous rectifiers.



A new kind of fabricated 3-ply tubular cathode, which acts as its own heater and thus permits a 40 per cent power saving, features the 3DG4 high vacuum rectifier now in production at General Electric.

The total cathode and plate dissipation of the 3DG4 is 26 watts, compared to 42 watts for the 5U4GB, a substantial saving in power loss and wasted heat.

The type 3DG4, is an octal-based full-wave rectifier designed for television and communications receiver, and small transmitter power supplies. Its cathode provides the advantages of both the traditional filamentary and heater type tubes. The 3DG4 cathode literally carries the heater current and thus heats itself. It requires 3.3 volts at 3.8 amperes.

This design offers several advantages. It permits use of a relatively large cathode emission surface, as opposed to the wire cathode of filamentary type rectifiers. Tube voltage drop is less than half that of older high vacuum rectifiers in similar service.

Elimination of a separate heater eliminates the possibility of heater-cathode failures through arc-over, break-down or burn out. Finally, the new large-surface cathodes in the 3DG4 provide exceptional mechanical strength.

Cathode heating time of all three types, the 3DG4, 5AR4 and 6CA4, approximates that of other cathode type tubes. Thus, the power supply voltage surge which usually occurs with fast-heating rectifiers, before slow-heating tubes draw plate and screen currents, does not happen. Filter and bypass capacitor breakdowns from this cause are minimized.

In addition to the 3-ply cathode material, new 3-ply plates have been incorporated into the 3DG4, 5AR4, and 6CA4. The bonded plate material, shown in Fig. 1, spreads heat evenly, uses it where it is needed, and dissipates heat efficiently where it is not needed.

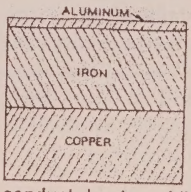


FIG. 1 CROSS SECTION Drawing of 3-ply plate material in G-E rectifier tubes. The bonded plate material employs copper both to conduct heat rapidly and to reflect heat where needed, aluminum to radiate heat, and iron to provide strength.

The 5AR4 and 6CA4 are especially suited to compact "low-profile" equipment because of their low seated heights, 2-7/8" and 2-13/16", respectively.

Typical operating conditions for these new rectifiers are given in TABLE I. For performance comparison, ratings of the 5U4GB also have been listed. Complete technical data for all types is available upon request to the G-E TECHNI-TALK office.

TABLE I — CHARACTERISTICS AND OPERATION —
FULL WAVE RECTIFIERS WITH CAPACITOR INPUT FILTER

Tube Type	3DG4	5AR4	6CA4	5U4-GB
Cathode	Coated Directly Heated	Coated Unipotential	Coated Unipotential	Coated Filament
Heater Voltage, AC or DC	3.3 ± 10%	5.0 ± 10%	6.3 ± 10%	5.0 Volts
Heater Current	3.8	1.9	1.0	3.0 Amperes
AC Plate-Supply Voltage per Plate, RMS	275	550	350	450 Volts
Filter Input Capacitance	40	40	50	40 Microfarads
DC Output Current	350	160	150	275 Milliamperes
DC Output Voltage at Filter Input	300	620	347	460 Volts
Tube Voltage Drop	25	17	20	50 Volts
at Current Per Plate	@350	@225	@150	@275 Milliamperes

"WHIPPANY"

From RCA Victor "Plain Talk and Technical Tips," *May, 1959.*

Have you ever heard of the "Whippany Effect"? This is a condition that is occasionally found to exist within a receiving tube that can cause ill effects in the operation of certain types of receiver circuitry. When "Whippany" exists within a tube, the tube will not draw grid current properly; and if the tube is used in a circuit designed to draw grid current, grid bias will not develop as it should and the circuit will not function properly. The degree of effect a "Whippany tube" will have on the performance of a circuit depends upon the RC values of the components used in the grid circuitry of the stage in which the tube is employed. Whippany has been noticed in some of the 6CG7 tubes used in the Blanker/G-Y amplifier position in CTC9 color television receiver chassis. The overall result reveals itself in a hazy picture lacking resolution. If such symptoms appear in the picture of color television receivers using a CTC9 chassis (model 210-CK-855 series), try replacing the Blanker/ G-Y amplifier, V705. It may be necessary to try more than one tube to correct this problem. 6CG7s which exhibit this effect in the V705 position can be used in other circuits of the receiver employing this tube with no detrimental effects. In addition to changing the 6CG7, when the above conditions exist, it is recommended that the following circuit modifications be made in the grid circuit of the Blanker stage of the CTC9 chassis to make the circuit less immune *[sic]* to any "Whippany" characteristics that may exist in 6CG7s that may be eventually used in this circuit. See RCA Victor Service Data - 1959 No. T6.

Change R740 from a 33,000 ohm ±5%, 1 watt resistor to a 120,000 ohm ±5%, 1 watt resistor, and change R742 from a 2.2 megohm, ±10%, 1/2 watt resistor to a 1.0 megohm ± 10%, 1/2 watt resistor. These resistor changes permit the blanking circuit in the CTC9 chassis to accommodate a wider characteristic variation of the 6CG7 tube (V705B).

The derivation of the name "Whippany" is unclear. It may come from the town in New Jersey where Ball Labs had its Radio Laboratory, and where radar development took place during WW II. The effect may have been noticed in a radar synchronizer or some other digital circuit involving tubes driven into grid current.

The matter didn't end with 6CG7s in this particular 1959 color set. In 1964 RCA registered its 6LF8, which was a 6AW8 miniature triode-pentode, "controlled for 'Whippany' effect," and its paralysis of plate current. It was for "applications using positive triode grid operation." The new tube could be operated with up to +4 volts on the grid and current up to 8 mA.

FM BARRAGE JAMMING - AN IDEA BEFORE ITS TIME

Danial Stocks

It was in the 1950s that electronic countermeasures really began to take hold as a field of its own, with dramatic advances in capability due to newly developed devices such as the Carcinotron and TWT. There was however, considerable use of jamming techniques during WW II, much of which was declassified and largely discarded post-war, on the grounds that it had been specifically developed for use against German and Japanese radar systems.

During WW II some such radar countermeasures were kept in strictest secrecy, presumably due to fears that the enemy may discover and make use of them as well. One particular idea that appears to be a bit before its time was development of swept FM jamming, a technique more commonly associated with the development of the Carcinotron almost a decade later.

Basically, a CW carrier swept rapidly across a broad band will inject an impulse into the filter of a radar receiver as it crosses the receiver passband. The nature of the impulse is usually determined by the receiver IF filter bandwidth.

With rapid, repetitive crossings of the receiver passband, a series of impulses are injected into the receiver. With proper modulation characteristics applied to the transmitted signal, the injected jamming signal could be made indistinguishable from an increase of the receiver noise floor, and at the time of its widespread deployment in the 1950s-1960s, no existing equipment was immune to the effects of such jamming. Key to implementation of such a jamming method is a wideband voltage-tunable microwave oscillator, preferably of high power output capability.

A recently discovered report, *'Centimetre-Wave Barrage Jamming by Means of Voltage-Tuned Valve,s'* details FM-jamming experiments performed in England during WW II. It describes the 1943 development of wideband FM jamming, approximately a decade prior to the period in which it such methods were generally implemented. This was something of an idea out of time, as the state of technology during WW II was simply not up to the task. Microwave radar technology was in its infancy, and none of available microwave tubes had the required features to produce this form of jamming effectively. Broadband tubes such as TWTs, Carcinotrons or Voltage-Tunable Magnetrons would not be available for some years.

Much of the existing WW II S-Band radar equipment of the UK was spread over a band of approximately 120 MHz centred around 3000 MHz. It was desired to understand what techniques could be brought about to produce a jammer capable of operating over this entire bandwidth.

Jammers based on CW magnetrons existed for UHF radar bands with high power levels obtained in the 6000MHz region, and it was believed that similar results could be achieved at S-Band. However, it was thought that it would not be practical to obtain a very wide bandwidth through modulation of such a device, as the magnetron was only able to be amplitude modulated over a limited bandwidth.

The best available tubes suitable to the task of wideband frequency modulation jamming were velocity-modulated oscillator tubes that existed at the time, such as reflek klystrons and Heil tubes. Electronic tuning ranges could be obtained from these tubes of approximately 100 MHz (50 MHz each side of the centre frequency) before the output power started to drop significantly. The output powers available were not high, usually tens to hundreds of milliwatts. Nonetheless, the existing technology was sufficient to demonstrate the technique in a rudimentary fashion and prove its effectiveness.

An experimental study into FM barrage jamming made use of an STC DV27 Heil tube that produced approximately 50 mW of RF output in the 2500-MHz range. Measurable output from the experimental setup was detectable on a cavity wavemeter over approximately 80 MHz when the tube was modulated by a 1-MHz sawtooth waveform. The jamming waveform was detectable in a radar receiver over a 170-MHz range.

The manufacturer of the Heil Tube (STC) suggested that they had a tube available in the 3000-MHz range that could produce 400 mW output when modulated, with a 3-dB bandwidth of 50 MHz each side of centre frequency. They were unable to define any

clear limitation on the power output of such tubes but thought that in principle that a device with a further 5 to 10 times the output power should be possible, making for a output powers of two to four watts.

It was estimated that a 2-watt tube modulated to jam a 100-MHz bandwidth would produce 50 mW per radar channel of 2-3 MHz bandwidth (the typical bandwidth of the radar of the era).

This would not be sufficient to completely jam a radar such as the GL *[Gun-Laying]* Mk III, but would noticeably reduce the operating range. It was estimated that such a jammer radiating from a dipole antenna (i.e., without directional transmission) carried by the target aircraft would reduce the range of the radar from 30,000 yards to 26,000 yards.

Overall, the results of the experimental work were very much a rudimentary proof-of-concept. However, the concept could have been developed further into a reasonably effective system.

For example, operating with a directional antenna of 10-dB gain, a 2W transmitter could radiate jamming power of 0.2 W / MHz over a 100-MHz bandwidth, and operating over half the bandwidth would give a power density of 0.4 W / MHz. This is about an order of magnitude lower in power density than was produced by early experimental Carcinotron jammers a decade later (typically 3-4 W / MHz).

Additionally, high-level broadband noise generators were known of, as they formed a part of many AM-based noise jamming equipments. Such a noise source could conceivably have been re-tasked to provide modulation for the FM barrage jammer. (Basically, the same 6D4 thyratron-based noise sources were used for FM barrage jammers a decade later). While there may have been some limitations in available power, all the required concepts were in hand to produce an FM-by-noise barrage jammer that would have been state-of-the-art a decade later, with only a moderate amount of additional development. It appears, however, that this was not pursued beyond the initial investigatory phases.

This research was accorded the highest secrecy. The report was coded Most-Secret, which is the highest security level seen for an Electronic Countermeasures report. The file was marked 'closed until 1972'. No rationale for the level of secrecy is given, but perhaps it was to do with the concern that the enemy may be able to devastate Allied radar should they also learn of the technique.

It would seem that this secret invention was shelved and forgotten about. No other known electronic countermeasures documents refer to this report. Nor has any other related work from the period been found. The concept of FM-modulated barrage jamming was seemingly completely redeveloped with the advent of wideband voltage-tunable microwave-oscillator tubes in the 1950s. The majority of the Carcinotron-based jamming information was classified 'Secret', and significant parts of the known jamming knowledge were declassified and made publicly available in 1971. The entire field of FM noise-jamming appears to have been re-invented, used in combat, and subsequently partially declassified and published, all before the original work was due to re-appear.

Nothing else is known as to what became of the original work or the people who developed it. Neither author appears as a contributor to any published work in the IEEE Xplore database, nor have any other works been found elsewhere from these authors.

REFERENCES

Connelly, C.M.; Elliot, W.S.
"Centimetre-Wave Barrage Jamming by Means of Voltage-Tuned Valves"
(Most Secret / Closed until 1972)
A. D. R. D. E Research Report No. 242
28 Dec 1943
Nat'l Archives (UK) AVIA 26/1435

"The M-Type Carcinotron"
Stocks, D.
TCA Special Publication No. 26 (2018)

Boyd, C .b .J. A.,
"Electronic Countermeasures"
(secret). 1961 reprint ed. 1961, University of Michigan. Institute of Science and Technology, United States. Army. Signal Corps: Peninsula Publishing. (Chapter 2)

"Final Report of Project Lamp Light"
(Secret). Vol 1, Ch 4, Appendix 4-A: Anti-Jamming Measures for Surface-to-Air Radars, 15 Mar 1955. Massachusetts Institute of Technology ((DTIC AD311318)): pp. 4-15 – 4-19.

Silvester, D .D. P., J. A.
"Note on A. S. R. E. Experimental X-Band Barrage Jammer"
(Secret) A. S. R. E. Technical Note WX-57-1, 1 Jan 1957. Admiralty Signal & Radar Establishment (ADM 220/830).

[The Heil oscillator tube is in Danial Stocks, "Heil Tubes," TC, June 2002, pp. 4-8. - Ed.

RCA RADIOTRON COMPANY, INC
HARRISON NEW JERSEY

R. T. Cunningham Inc.
415 SO. FIFTH ST., HARRISON, N. J.

UNIFIED SALES - ENGINEERING SERVICE TO EQUIPMENT MANUFACTURERS

MEADE BRUNET, Manager
HARRISON, NEW JERSEY

APPLICATION NOTE
No. 35
February 26, 1934

APPLICATION NOTE ON TRIODE OPERATION OF TYPE 42 AND TYPE 2A5 PENTODES

The 42 or the 2A5 when used as a triode in push-pull audio amplifiers gives good power output and low distortion. In this Application Note, operating conditions and performance results are given for these tubes in over-biased push-pull amplifiers having (a) fixed-bias voltage from a battery and (b) self-bias voltage from a cathode resistor. Both driver and output stages use the same tube type connected as a triode.

Optimum performance results for fixed- and self-bias conditions are shown in Figures 1 and 2, respectively. From these curves, it is apparent that the greatest power output is obtained with the fixed-bias condition. This represents the ideal case because the fixed bias from the low-resistance battery employed minimizes degenerative effects. When the grid-bias voltage is taken from the power-supply voltage divider (semi-fixed bias) or from a self-biasing resistor, the power output is reduced for two reasons. These are (1) that the bias-voltage fluctuates due to change in d-c plate current with signal and (2) that the bypassing of the a-c component around the biasing resistor may be inadequate. Ordinarily, the power output will be somewhat less with self-bias, because this arrangement generally has the poorest regulation. Semi-fixed bias will give results between the fixed- and the self-biased arrangements. The curves of Figure 2 show the optimum power output that can be obtained with the self-bias arrangement under the given conditions. In this case, sufficient capacity was used across the cathode resistor to reduce its impedance to a negligible value.

Copyright, 1934 by
RCA Radiotron Co, Inc.

The following Table gives the essential data for triode operation of two 42's or two 2A5's as over-biased push-pull audio amplifiers. This kind of amplifier is identified by us as a Class AB amplifier. Class AB operation is intermediate to Class A and Class B operation.

Table I

Driver tube: Type 42 or Type 2A5; plate volts = 250; grid volts = -20; screen tied to plate.

Output stage:: Two Type 42's or Type 2A5's, with no signal input, plate volts = 350 and grid volts = -38.

	Fixed Bias	Self Bias	
Driver Plate Load	24600	25200	Ohms
Interstage Transformer Ratio			
Primary to ½ Secondary	1.6 to 1	1.14 to 1	
Transformer Efficiency	84.5	65.0	Per Cent
Peak Grid Voltage on Output-Tubes (per Grid)	63.5	82.15	Volts
Peak Power Input to Grids of Output Tubes	366	300	Milliwatts
Plate-to-Plate Load	8000	8000	Ohms
Power Output (5% Distortion)	18.4	14.8	Watts
Self-Biasing Resistor	-	730	Ohms

The following Table gives the characteristics of a 42 or a 2A5 for triode operation as a Class A audio amplifier.

Table II

Plate Voltage	250 max.	Volts
Control Grid Voltage	-20	Volts
Plate Current	31	Milliamperes
Mutual Conductance	2300	Micromhos
Plate Resistance	2700	Ohms
Load Resistance	3000	Ohms
Power Output	650	Milliwatts

From Table I, it will be noted that the driver tube is required to supply peak input power of either 366 or 300 milliwatts to the grids of the power tubes. When transformer efficiency is taken into account, the driver must supply 434 and 460 milliwatts peak, or 217 and 230 milliwatts RMS, for the fixed- and self-bias con-di-tions, respectively. These operating requirements are well within the capabilities of either the 2A5 or 42, since either type as a driver is capable of supplying 650 milliwatts (see Table II).

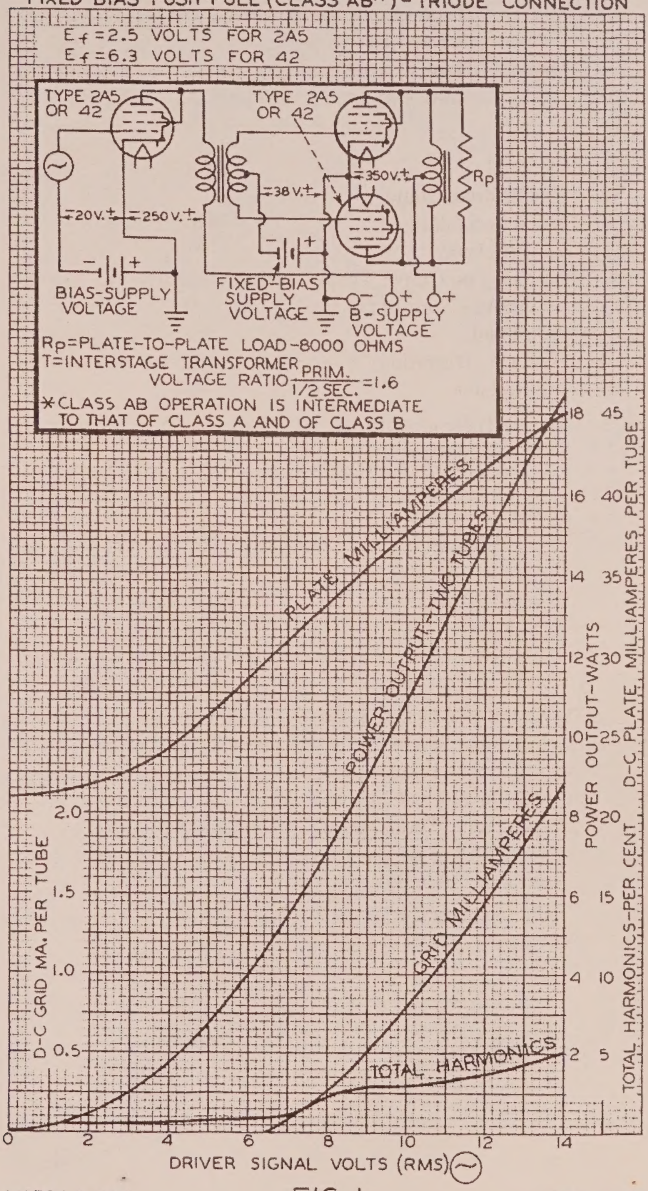
(Figs. 1 and 2 replaced per Errata Notice of March 1, 1934. Not predicted at the time: this Note would also apply to the 6F6. - TCA Ed.)

Radiotron — Cunningham RADIO TUBES

RCA-2A5, RCA-42 — C-2A5, C-42

OPERATION CHARACTERISTICS

FIXED BIAS PUSH-PULL (CLASS AB*) - TRIODE CONNECTION



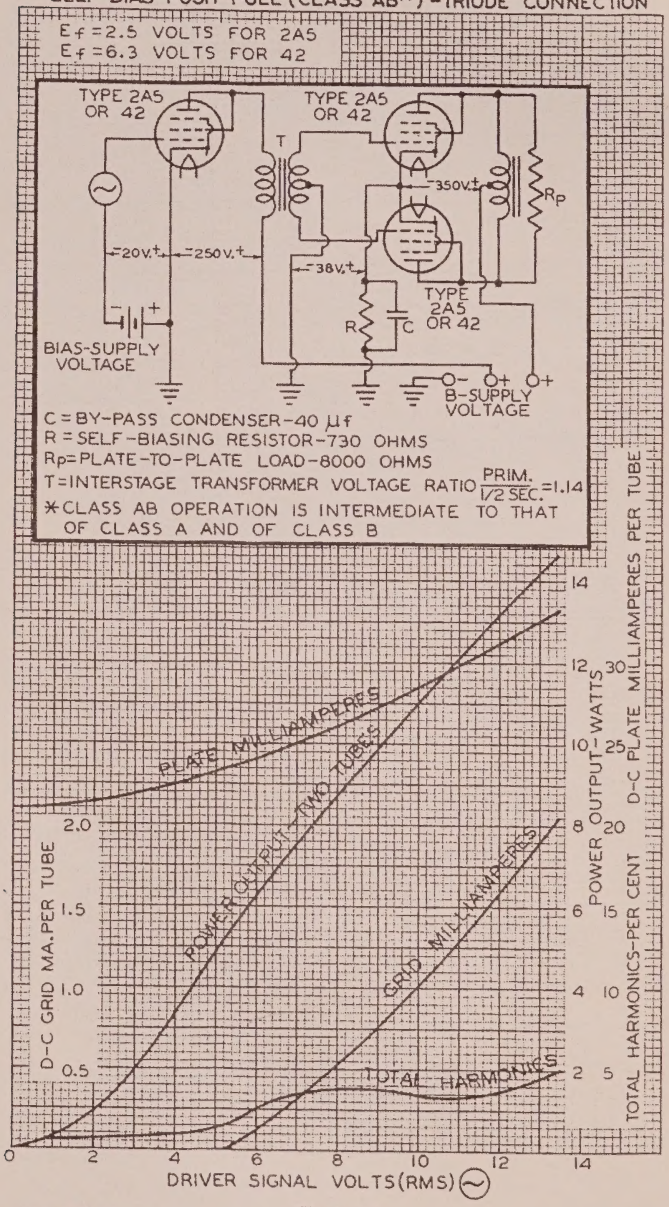
MARCH 1, 1934 — FIG. 1 — 925-5461F

Radiotron — Cunningham RADIO TUBES

RCA-2A5, RCA-42 — C-2A5, C-42

OPERATION CHARACTERISTICS

SELF BIAS PUSH-PULL (CLASS AB*) -TRIODE CONNECTION



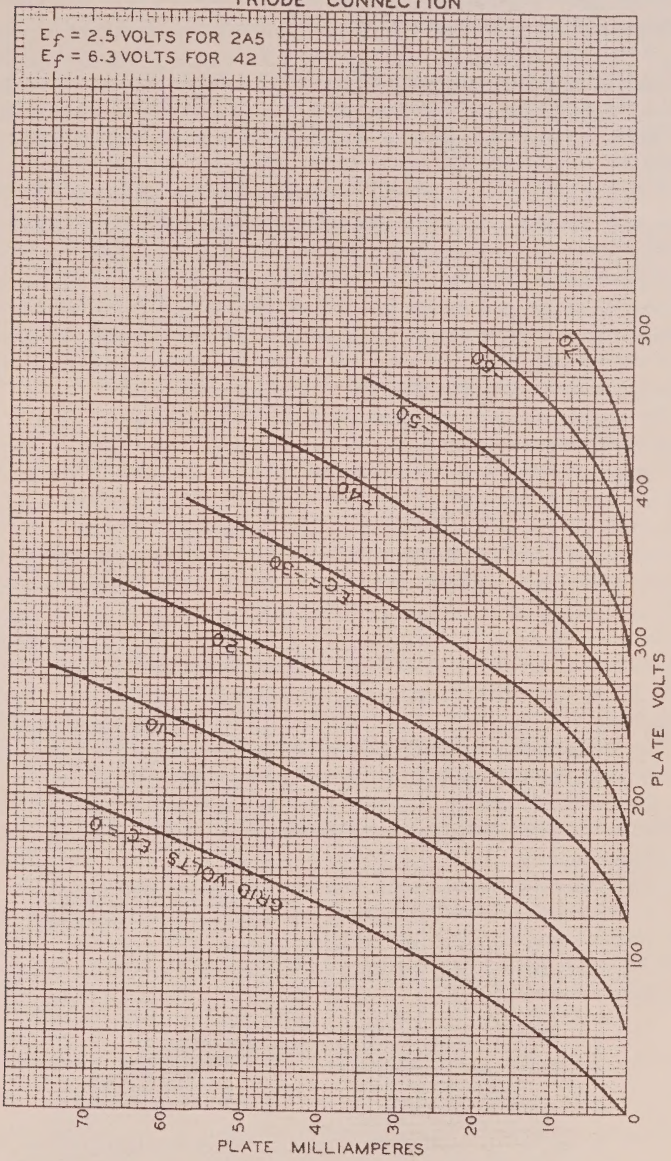
MAR. 5, 1934 — FIG. 2 — 925-5460R1

Radiotron Cunningham RADIO TUBES

RCA-2A5, RCA-42 C-2A5, C-42

AVERAGE PLATE CHARACTERISTICS

TRIODE CONNECTION



FEB. 16, 1934

92S-5459

TRIAD METAL SHIELDED RADIO TUBES

SERIES MG

TECHNICAL BULLETIN

TRIAD MANUFACTURING CO., INC. - PAWTUCKET, R. I. - U.S.A.

This comes from the RMA registration notice on Triad's line of metal-glass tubes, on Release 34 in July 1935. It came out a month or so after others brought out glass contenders versus GE's and RCA's "original nine" metal types. It covers the nine, plus the orphaned 6D5. It cleverly aids the construction of AC-DC series-string sets by adding the 25Z5 MG rectifier and 43 MG output tube. There are also two plug-in ballast lamps to replace "curtain burner" resistance cords or other resistors . . . giving what looked like an extra tube in the radio. - Ed.

Triad Manufacturing Company is pleased to announce a new line of tubes known as the MG series. Consistent with its established reputation for progress and individuality, Triad has produced a non-breakable, fully shielded, metal tube in which a newly developed glass is used for maintaining the vacuum. By this method the same vast experience accumulated in several decades of lamp and radio tube manufacture, is not suddenly upset and consequently, the Triad series MG will have the same long and serviceable life that has characterized properly made glass sealed tubes in the past.

Certain highly publicized so-called metal tubes now available, consist of a series of glass to metal seals in addition to several metal to metal welds. By this construction, the overall height of certain tubes is reduced but it is the contention of the Triad Engineers that the series MG described herein offers the same technical advantages, a greater sales appeal, and less inherent risk to the manufacturer adopting these types.

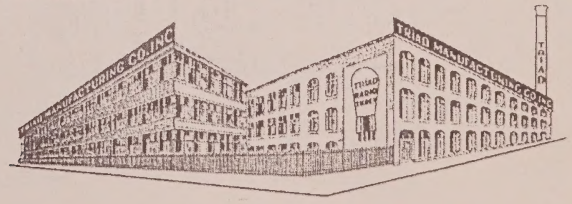
It should be further noted, that the Triad series MG is not a line of tubes for some indefinite date in the future. Equipment has been installed during the past several months to produce 10,000 of these tubes per day for immediate delivery to manufacturers adopting the Triad line. This new line of tubes has the further advantage of being designed such that it is fully interchangeable with the existing metal tubes. The new standard octal bases are used throughout and base wiring is in accordance with the standards of the Industry.

As a further advantage, the manufacturer is offered four additional types for AC-DC uses. These types have the same characteristics as the corresponding glass types, but they have been re-designed to conform with the metal tube series.

The rating and basing arrangements of the MG series will be found elsewhere in this bulletin. A brief description of the MG types may be of help in becoming familiar with the new type numbers.

5Z4 The 5Z4 is a cathode type, full wave rectifier having low voltage drop for general use. It has approximately half the voltage drop of the corresponding glass type 80. Heater and cathode are tied together internally.

6A8 This tube is essentially the same as the type 6A7, except for the additional pin tied to the external metal shell.



6C5 This tube is a triode detector-amplifier very similar in characteristics to the familiar 6C6 when the latter is connected as a triode.

6D5 The 6D5 is a power amplifier triode. Its characteristics are quite similar to the type 42 when the latter is connected as a triode.

6F5 This high-mu triode is practically the same, so far as electrical characteristics are concerned, as the triode section of the familiar type 75. The grid connection is brought out through the top cap.

6F6 The metal type 6F6 is electrically similar in all respects to the type 42 when employed as a pentode power amplifier.

6H6 This double diode is designed to provide for AVC and diode detection. It is similar in every respect to the double diode section found on multi purpose glass tubes except that both cathodes are brought out separately.

6J7 This hi-mu pentode detector amplifier is similar electrically to the type 77.

6K7 The 6K7 is a triple grid variable mu amplifier similar to the well known type 78.

25Z5 MG This special type is provided to fill the need of a rectifier for AC-DC sets and is similar electrically to the type 25Z5.

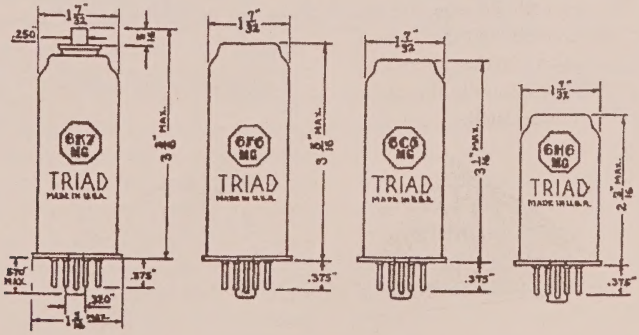
43 MG This type has characteristics identical to the 43 and provides a power output tube to complete the AC-DC line.

50A2 MG This is a ballast tube in a metal shell with a tap to supply two #40 pilot lights in series.

50B2 MG The 50B2 MG is designed for the same service as the 50A2 MG but tapped to supply a single #40 pilot lamp. Both ballast tubes have an overall voltage drop of 50 volts and are employed in transformerless receivers for AC-DC voltage. For example a 25Z5 MG rectifier, a 43 MG power output tube, a 6K7 R.F. amplifier and a 6J7 detector comprise a typical compliment *[sic]* for ballast tube operation.

This listing of metal shielded tubes should not be considered complete, but simply the list of types which are now in production. Considerable experimental work is being done on various types of metal shielded tubes at Triad. When this experimental work indicates that additions or changes should be made to our production types, improvements will be incorporated.

With the innovation of the new series MG tubes, it is assured that most of the basic and essential experience gained from glass tube processing will be incorporated in the making of the new metal glass tubes. These facts cannot be overlook *[sic]* so readily, in view of the widespread use and acceptance of the glass tubes. Combining this knowledge with the new principle of metal tube design, a most permanent and useful series of radio tubes has been developed.

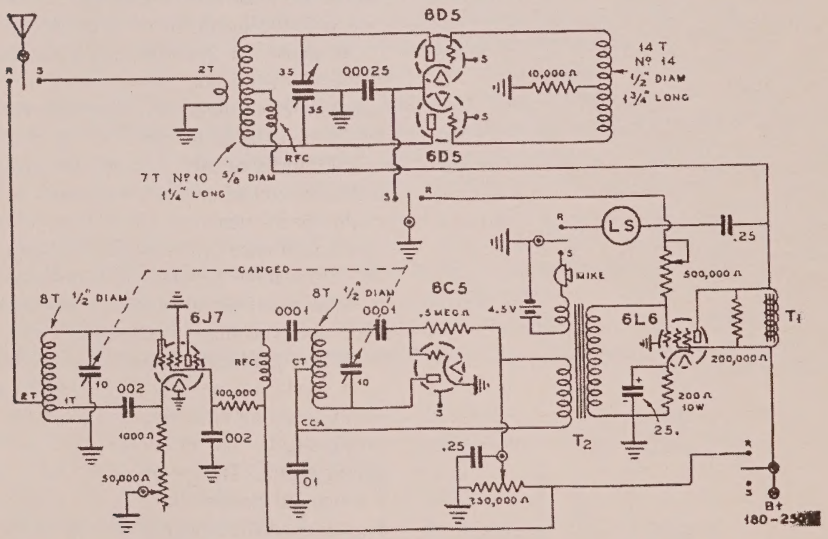


About the same time, Arcturus put out its "Coronet" series (covered in TC, August 2016 and April 2017), a similar glass-in-metal line with adapters to "modernize" existing radios. (The radio manufacturers don't seem to have bought this series.)

Triad added a few MG types, like the 6N5MG and 6Q7MG. A few radios were all-MG. The Silvertone models 1909, 1912, and 1962 sported a 6A8MG, 6K7MG, 6Q7MG, 6C5MG, push-pull 6F6MGs, and a 5Z4MG. Hytron also sold some MGs like the 6J7MG and 6K7MG, possibly made by Triad. So did Ken-Rad (a 6A8) and National Union (a 6Q7MG)

However, when Triad brought out its "Triadyne" group of output tubes (dual triodes with a cathode follower vigorously driving the output side) in 1935-37, they were glass types. These were the 6B5, 6AB6, 6AC5G, 6AC6, 25B5 and 26N6G. (There may have been a few MG versions of the 6B5 and 6N6G.) In any event, their June 1937 product list shows nothing "MG" or metal in any other form.

In regard to the ill-fated 6D5, RCA designed it and did some pilot production. However, a manual scan of the 1938 Mallory-Yaxley Radio Servicing Encyclopedia shows nothing using the tube. Use of the "Radio Finder" search feature of John Okolowicz' www.grillecloth.com automatically searches it and two other data bases, and gives the same answer. However, there was one known application. The 1937 edition of the Jones Radio Handbook (Frank C. Jones, editor) shows a "metal tube 5-meter transmitter-receiver" in which the transmitter is push-pull 6D5s! "The 6D5s are similar to glass type 45s."



NOTES ON THE USE OF THE ULTRAUDION

This item comes to TCA via the chain George Clark - to G. F. J. Tyne - to Jerry Vanick - to Joe Gruber.

Dr. Leonard Fuller was chief engineer of Federal about the time that De Forest worked at the company's lab in Palo Alto. He was largely responsible for Federal's huge holding of patents for arc transmitters of up to megawatt size, which were critical to Navy communication during WW I, but which faded into history as alternators and big tube setups became possible.

History San Jose has massive amounts of history on Fuller and Federal, largely gathered by Douglas Perham of the Perham Foundation - who had also worked for Federal! The Wikipedia entry on Fuller is extensive and plausible.

Federal, in its role as a wireless operating company, had a need for heterodyne receivers, as the arc signal was basically continuous-wave (with some phase jitter giving a signal with "hair" on it).

Joe deserves considerable thanks for supplying this story. - Ed.

Notes prepared by L. F. Fuller of the Federal Telegraph Co.
11-17-1914
Copied April 8, 1937 by G. H. Clark from Fed. Tel. Co.
files, Newark N, J., by permission of Haraden Pratt.

USE OF THE AUDION AS A HETERODYNE "ULTRA AUDION"

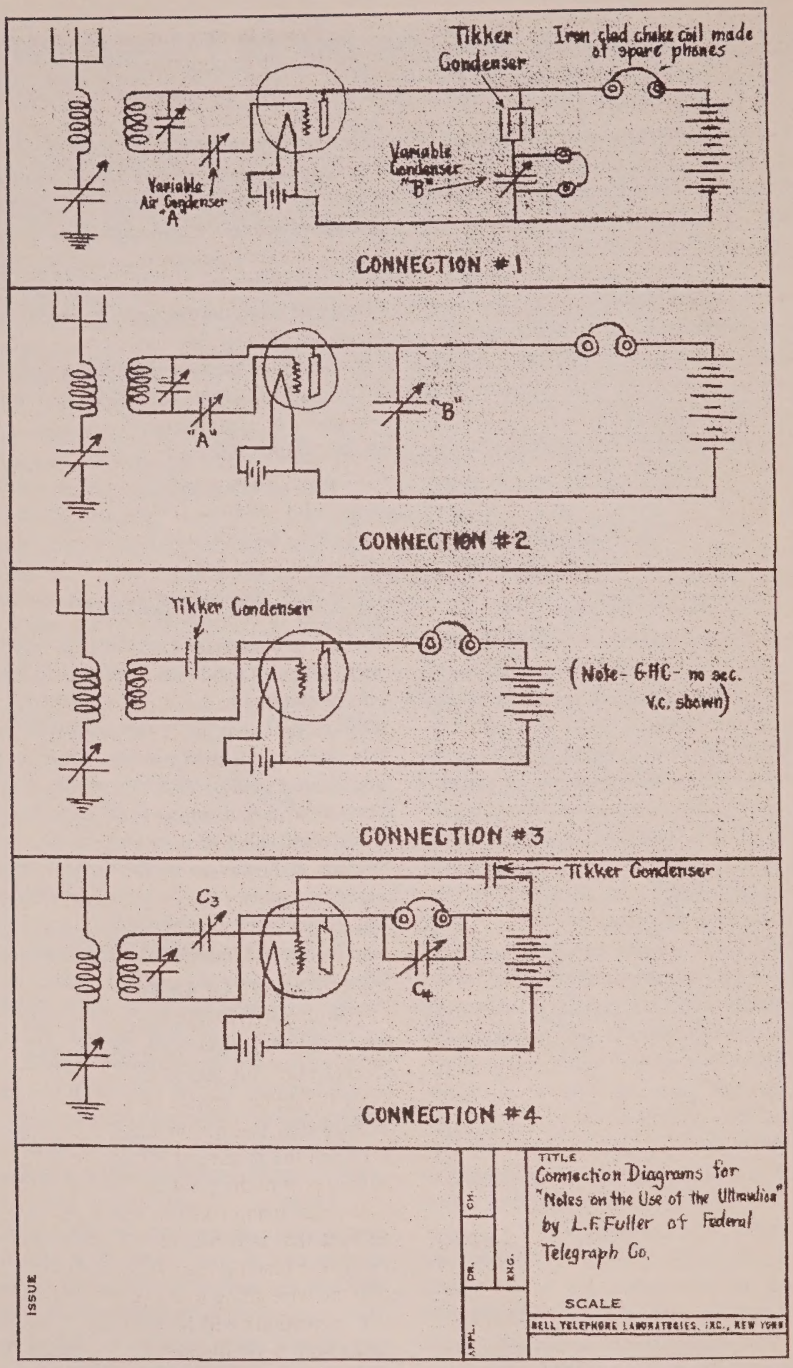
It has been found by Dr. de Forest that if an audion be set up with an inductance and capacity connected to the grids and plate (not connected at all with the filament) under correct conditions as to heating of filament and excitation by the battery of dry cells, the audion acts as a generator of high frequency continuous oscillations, oscillating at a period determined by the inductance and capacity placed around the grid and plate.

This inductance and capacity can as well as not be the secondary elements of a radio receiver. This secondary circuit may be connected to an antenna and may act at the same time both to receive any signal which the antenna picks up and to have continuous oscillations set up in it by the audion oscillator.

Let us suppose that signals are coming in on the antenna from a distant arc station with a frequency of 300,000 cycles per second. If the secondary circuit of the receiver were tuned for this signal, this circuit would therefore have a period of 300,000 and thus the oscillations set up in it, due to the audion oscillator, would be of this same value.

Now let the secondary circuit be slightly detuned from the value required for resonance with the incoming received signals. For example, let 2 C2 be adjusted to a frequency of 301,000. This slight deviation from exact tuning will be practically negligible as far as its effect on the question of transfer of energy from the antenna to the detector circuit is concerned. But another phenomenon of the highest interest enters at once as a result of this detuning. Oscillations generated by the audion oscillator are of slightly different frequency from the incoming oscillations, and "beats" are produced. Thus, we are enabled to produce a musical note at will by simply throwing the secondary or detector circuit slightly out of tune with the incoming signal. The apparatus now becomes at one and the same time a detector of oscillations and a heterodyne or beat producer.

A discussion of what might go on in case the two circuits were in exact resonance is not of great value, as it appears that with the audion now in use the apparatus ceases to act as an oscillator when the two circuits are in resonance. This is apparently due to the antenna circuit absorbing the energy from the oscillating circuit



Diagrams copied by Tyne, from his handwriting and use of a Bell Labs form - Ed.

at too rapid a rate. Exactly the same effect was noted in the early days of the arc, when small ¼ kw sets were in use. If the sets were connected to a good antenna with good radiating power, the arc was immediately extinguished, a fact that of course was absent as soon as arcs of greater capacity were produced, further developments along this line may be expected. As it is, certain effects are noted when spark signals are being received with the two circuits in resonance.

Certain limitations have shown up in the practical use of this form of connection, however, which is given as connection 3 on the accompanying wiring diagram.

A most important limitation is in the value of the secondary condenser that can be used. If the condenser be increased over .0005 mfd the audion ceases to act as generator. This corresponds to a setting of five or ten degrees on a standard Federal Telegraph Co. variable condenser, thus for receiving long waves it becomes necessary to use very large secondary inductance L, which on a account of the high losses thereby introduced, is very objectionable.

A scheme of connection has been developed which entirely obviates this difficulty, and at the same time provides other valuable control features. This is shown in connection 4.

C-3 and C-4 are variable condensers, the former having a maximum value of about .001 and which corresponds to about 70 or 80 degrees on a standard Fed. Tel. Co. variable condenser, and the latter a maximum value of say .003 mf, corresponding to about 180 degrees on one of our condensers. It is essential that the condensers be connected as shown, and that the leads from the secondary circuit of the receiver be likewise connected as shown.

C-3 takes the place of the fixed stopping condenser (tikker condenser) shown in connection 3 and serves a much more useful purpose. Its critical value is about .0002 mfd, that is, below this value the audion will not generate oscillations. There is no reason to vary this condenser unless it is desired to eliminate static, this condenser serving quite markedly to out down such disturbances.

At the critical value of .0002 mfd, static comes in very easily, but as the condenser is increased beyond this value, the effect of the static becomes less and less. This effect is very marked. Increasing this condenser beyond the critical value also lowers the resultant note heard, but the elimination of static far outweighs this *(See note at end. GHC)*

The value of the variable condenser C-4, is widely different for different wave lengths. For 1000 meters (below which it is nearly impossible to get the audion to generate oscillations, whereas at 4000 meters, for instance, it may be as large as .002 mfd, and for still longer waves becomes correspondingly larger. This condenser also acts somewhat as a vernier condenser in connection with the secondary tuning condenser C-2. Whereas it is very difficult to move the latter by sufficiently small graduations to produce exactly the note that the operator desires, by varying C-4, this note can easily be made any desired value. C-3, as above noted, can also be used to adjust the note.

The chief value of the above method of connection, however, lies in the greatly increased secondary capacity C-2 which can be used and still have the audion act as a generator or oscillator.

ADJUSTMENT OF ULTRA AUDION

Assuming a Wireless Specialty receiver to be used, cut in 160 turns in the secondary and place the secondary condenser at about 40 degrees, start B battery at the forest *[sic]* step, and increase the heating battery from the minimum value. Touch the binding post of the condenser C-3 with the finger, care being taken to touch the binding post that is connected to the secondary. If the binding post which is connected to the wire going to the grid is touched, false indications will be obtained. When the audion is oscillating, a click will be heard in the telephone each time the finger

is touched to the post. If the first step of the B battery is not sufficient, *[g]*o to the second step and repeat. When the Audion is once set oscillating, it is possible to adjust C-4 for the particular wavelength in use by the same test.

Vary C-4, gradually touching the finger at frequent intervals to C-3 as above. Vary C4 until the clicks are no longer heard, then vary in the opposite direction until they reappear. This will be the correct setting for the wavelength used.

Connections 1 and 2 accompanying are modifications of connections 3 and 4. Connection 3 was the original invention, and connection 4 a recent improvement. Connections 1 and 2 work about as well, and sometimes are preferable to connection 4. The general values of condensers and the means of operating the ultra audion under the connections 1 and 2 are similar to those described above, which are given in detail for connection 4.

In first using the ultra audion set obtained from the Honolulu Naval Station, it is suggested that you connect as shown in No. 3, unless the set be already connected for use. Having obtained a little experience with connection 3, go to connection 4 and then try 1 and 2, and use you own judgment as to which you find preferable. The detailed information given above is for connection 4, but as mentioned above it will apply to connections 1 and 2 to a greater or lesser degree.

LFF/K
11/17/14

Note GHC 4-8-1937. Referring to statement at middle of page 2 as to adjustment of ultra audion, note the statement as to elimination of static by change in condenser. Note also statement as to "lowering the note". If he refers here to reception of c. w. signals, "lowering the note" could, it would seem, be remedied by revarying condenser C-4. But if he is referring to receipt of spark signals, the whole reference is clear. Increasing C3 is analogous to changing the tickler coupling in a later type of set; the "lowering of note" means what we later called "roughening" of the note; the "elimination of static far outweighing this" means, as we found later, that the readability of the signal was made better, even though its note was "lowered".

Admittedly, the general tone of the report seems to indicate that he is referring to c. w. reception, except that the statement "lowering of the note" by change of C-3 doesn't seem to mean anything, as he has already said that the note can be brought back by change of C-4. But if he is referring to receipt of spark signals, the whole reference becomes clear.

LOCATING GASSY TUBES

Philco Serviceman, Nov and Dec. 1959; Jan. 1960

Gassy tubes produce a variety of perplexing problems for the radio and TV serviceman. In some cases, a single gassy tube in a set will cause peculiar operational symptoms that greatly increase the difficulty of reaching an intelligent diagnosis of the trouble. In other cases, a gassy tube will be on its best behavior during the time while the set is under repair and observation, but will "act up" in the customer's home after the set has been operating for several hours.

In order to solve difficult service problems, reduce the number of callbacks on repair jobs, and increase the list of satisfied customers, the serviceman needs to be familiar with the behavior of gassy tubes in different circuits and under various conditions.

Why Not Rely on the Tube Tester?

Some tube testers have a gas test feature incorporated in their circuitry. This test may prove successful if you happen to be testing the offending tube when it is in a troublesome mood, and if the tube operating conditions in the tester are similar to those in the set. However, these two circumstances cannot be expected to coincide in every case. Experience has proven that it is more practicable to locate the trouble while the tube is operating in the radio or TV set. The reason for this is that a period of set operation is usually required to obtain the full story on the symptoms. Some gassy tubes are in their worst condition when the set is first turned on, while others do not show any signs of trouble until they have been in operation for a long time.

What Causes Gas in a Tube?

Before considering the effects of gas within a vacuum tube, it is helpful to understand how gas gets into the tube in the first place. In the manufacturing process, the air is pumped out of the tube by means of vacuum pumps. Then, any gases that may still remain in the tube envelope or the metals comprising the electrodes are driven out by baking the tube, usually in a radio-frequency furnace. In the case of metal-envelope tubes, the metal shell is heated with a gas flame, and the removal of gases from the electrodes is assisted by electron bombardment, which is produced by operating the tubes in "aging" racks for the required length of time. Finally, the "getter" in the tube is flashed, and this removes any residual gas. A variety of getters are used, but most of them employ a small amount of volatile substance such as magnesium, barium, or phosphorus *[well maybe not Mg or P, in 1959 - TCA Ed.]*. The getter material combines with the gas molecules and produces solids, which are deposited on the tube envelope. The familiar silvery film which can be seen on the inside of the tube envelope is the result of getter action *[well, the cause, not the effect! - Ed.]*. Some getters employ material that is capable of absorbing gases. In many types of tubes *[or, say, all ! - Ed.]* the design of the getter is such that it continues to eliminate gases that may occur while the tube is in service.

We are now prepared to consider how gas "gets into" a tube. This knowledge will, in turn, help us to know when to suspect that a tube may be gassy. There are two common causes of gassiness: (1) as the tube is used more and more, a condition is reached in which gas is released from the electrodes faster than the getter can eliminate it; (2) minute 'quantities of air (which contains various gases) leak into the tube through the seals where the electrode connections are brought out. Some times the gas is caused by a combina tion of these troubles.

The release of gas from the tube electrodes occurs mainly through electron bombardment and heating. Gas is driven out of the plate and the grids in this manner. Also, when the emitter coating on the cathode becomes partially exhausted, gas molecules are "boiled out" of the metallic

body of the cathode. Furthermore, any gas existing in the tube tends to shorten the life of the emitter material. This will be discussed later.

Leakage of air into the tube can occur at regular intervals. As the tube heats up and cools off again during normal on-and-off use, there are times when the heat of the tube is such that wire electrode connections and the glass seals do not expand or contract at the same rate; thus, minute amounts of air are admitted to the interior of the tube.

Whatever the cause of gas build-up in the tube, the trouble is increased by partial failure of the getter. As the tube is used more and more, the getter deteriorates, so that it finally becomes incapable of taking care of the gas as fast as it is produced.

What Goes On in a Gassy Tube?

When electrons from the cathode collide with gas, molecules, an effect called ionization occurs — that is, positive ions are produced. These ions affect tube operation adversely in a number of ways. They are attracted to the cathode, because of the potential difference that exists. Because of the relatively large mass of the gas, molecules, when they strike the cathode they strip off some of the emitter material. This shortens the life of the tube.

Ions also neutralize some of the negative space charge, and this increases the flow of electrons from the cathode to the plate, which amounts to an increase in plate current. This alters the operating characteristics of the tube. It also increases the heat within the tube, and this can contribute toward the release of more gas from the electrodes.

Probably one of the most damaging actions of the positive ions results from the fact that these ions tend to collect on the control grid. This has the effect of making the grid bias less negative, and thus causes a marked increase in plate current. Again, the increase of heat in the tube helps to release more gas, as mentioned above. At the same time, the increased emission produces more electrons, so that more collisions occur between electrons and gas molecules, and thus the ionization becomes worse. These conditions persist over a period of time, causing faulty operation of the associated circuits, until finally the usefulness of the tube is destroyed.

It should be noted that the collection of positive ions on the control grid- is particularly injurious when there is a high value of resistance in the external grid circuit, as in the case of resistance-coupled audio amplifiers and r-f or i-f amplifiers operating in a-g-c or a-v-c circuits. The high grid circuit resistance allows the positive ions to make the control grid bias much less negative, if not actually positive. From observation of the above facts, it is easy to see why a small amount of gas ionization can be particularly detrimental to the operation of pentodes and similar high-gain tubes, whose normal control grid bias is a very small value, as compared to triodes.

It is thus obvious that a small amount of gas in a tube can change the input impedance, the gain, the control-grid bias, the plate-current, the operating point, the output impedance, and so on. Furthermore, the operation of the tube, although abnormal, will not ordinarily remain constant, but will vary gradually as the tube warms up to its task, and will then grow either' better or worse, depending upon whether the gas and the ionization are decreasing or increasing. Finally, the operation will become stabilized, although during the process it `may cause erratic operation of the radio or TV set. For example, a gassy horizontal oscillator tube in a TV set may cause the picture to tear or lose sync every fifteen minutes, requiring hold adjustments at regular intervals over a period of an hour or more until finally-the operation is stabilized. If the TV owner is an extremely patient person, he may be content to go through this performance every evening, but it is more likely that he will calla serviceman.

Symptoms Leading to Suspicion of a Gassy Tube

Diagnosing the cause of trouble in any radio or TV receiver begins by operating the set and establishing the relationship between the symptoms of trouble and some functional section of the set. (Of course, this procedure cannot apply when a set is completely dead. In such cases the set must first be restored to some semblance of operation before further checking can continue.) If there is some life in the set, observations on its performance will usually indicate the functional section primarily affected by the trouble. (A "functional section" is any section containing a circuit, or a group of circuits, that performs a basic function; e. g., horizontal sync stages, r-f stage, i-f amplifiers, audio output stage, etc.) More detailed observations and various tests and measurements can then be applied to this particular section until the trouble is narrowed down to the individual defective part.

With the set in operation, the serviceman observes the symptoms of trouble and considers the possible causes of these symptoms. When certain symptoms exist, he needs to consider the possibility of gassy tubes, along with the many other possibilities. Since it is the purpose of this story to deal only with gassy tubes, a list of trouble symptoms that can result from tubes in this condition is given below, to serve as a guide.

Radio Receivers

Tone Distortion:

This trouble can result from a gassy audio, r-f, or i-f tube. Distortion will be more noticeable in the case of a gassy audio tube. In the audio section, the audio output tube is the one that is most susceptible to gas troubles. In the r-f and i-f sections, the last i-f tube, if gassy, is the one most likely to produce distortion, because the presence of gas in this tube results in overloading the tube by the amplified i-f signal.

Loss of Reception on Part of Band:

Gas in the oscillator tube usually produces its first noticeable effect by causing the oscillator circuit to fail at the low-frequency end of the broadcast band, or to fail on all or part of the highest-frequency short-wave band. If the dead part of the band grows larger or smaller with continued operation, this is a strong indication of a gassy oscillator tube.

Gradual Fading:

Increasing gas ionization in an r-f or i-f tube causes a very gradual change in sensitivity of the set, sometimes over a period of several hours. Distortion may not be noticeable. A good way to check for distortion is to compare the tone quality of local stations with that of semi-distant stations, while maintaining the same volume level. Local signals may cause overloading of the defective tube.

Gradual Increase in Sensitivity:

This condition is the reverse of the one described above; that is, the gas ionization in an r-f or i-f tube decreases with continued use. The best opportunity to observe the trouble is during a short period of time after the set is first turned on.

TV Receivers

Tone distortion:

The same causes given for radio receivers also apply to TV.

Loss of Reception on H-F Channels:

Gas in the high-frequency oscillator tube usually shows up first by causing loss of picture and sound on the highest-frequency channel used. If this channel can be received only after a period of set operation, or if it is lost after a given period, this is a strong indication of decreasing or increasing (respectively) ionization of gas in the oscillator tube.

Gradual Change In Picture Width:

This trouble can be caused by gassiness of the horizontal oscillator tube, horizontal amplifier tube, or damper tube. If the picture grows narrower or wider with continued operation, this can be the result of an increase or decrease (respectively) of gas

ionization in one of these tubes. It should be kept in mind, however, that if the horizontal oscillator tube is gassy, changes in horizontal sync will also be observed.

Gradual Change in Picture Height:

The same causes given above for changes in width, apply to the height except that the latter involves the vertical oscillator and vertical amplifier tubes.

Gradual Change in Horizontal Sync:

Failure to maintain horizontal sync can result from a gassy sync separator tube, horizontal oscillator tube, or horizontal amplifier tube. Of these three tubes, the one most likely to become gassy is the horizontal amplifier tube. The reason for its effect on the horizontal sync is that gassiness reduces the input impedance of the amplifier, thus changing the load on the horizontal oscillator. This load changes gradually as the gas ionization increases or decreases during operation, thus causing instability of the sync action.

Gradual Change in Vertical Sync:

The same causes described above apply to the sync separator tube in the case of vertical sync troubles, and also to the vertical oscillator and vertical amplifier tubes.

Gradual Change in Picture Brilliance:

This trouble can result from changes in gas ionization in the horizontal amplifier tube, the high-voltage rectifier tube, or one of the low-voltage rectifier tubes. These tubes all affect the high voltage to the picture tube.

Testing for Gassy Tubes

The simplest way to determine whether a tube is gassy is to look into it while it is operating. If it is possible to see through the glass envelope of the tube, any gas ionization having sufficient intensity to affect the tube's operation will appear as a purplish glow between the electrodes. Of course, this visual inspection method will not work for metal tubes, or for glass tubes whose envelopes are mostly opaque. For metal tubes and opaque glass tubes, tests for gassiness must be made by the use of service test equipment and/or substitution of new tubes. Sometimes the tube substitution method can be used while observing the symptoms to see whether the trouble clears up. If the substitution appears to clear up the trouble, a double-check should be made by returning the original tube to its socket and again substituting the new one.

Test Equipment Required

Testing for gassy tubes with the set in operation requires a good 20,000 ohms-per-volt voltmeter, or a vacuum tube-voltmeter, which is used to take voltage readings from the grid circuits. If a meter of only 1000 ohms-per-volt sensitivity is available, a limited amount of testing can be done by observing cathode voltage, which serves as a guide to the amount of plate current.

A good r-f and a-f signal generator and an audio output meter provide a quick method of monitoring the output of the audio section separately, or the audio section combined with portions of the r-f and i-f system, to detect a change in sensitivity or audio gain and isolate the cause to the audio, i-f, or r-f section. With a steady audio output from the signal generator fed to the volume control, and the output meter connected to the speaker or output transformer, a few minutes of operation will usually indicate whether there is any change in the gain of the audio section. If no change occurs here, the signal generator can be re-connected to supply an i-f signal to the plate of the mixer tube, thus including the i-f section in the test.

Test Methods

Since positive ions collect around the control grid of a gassy tube, a "gas current" flows from the cathode around the grid circuit, t6 the grid. If there is a fairly high resistance in the grid circuit, the gas current produces a voltage drop across this resistance, with positive at the grid end and negative at the cathode end, as shown in Figure 1. Hence, the gas current produces a potential whose polarity is opposite that of the grid bias, thus canceling a

part of the negative grid bias.

If the tube is in a resistance-coupled audio circuit, like the one in Figure 1, the test for gas is made by connecting the 20,000-ohms-per-volt voltmeter across the grid leak, with the positive lead at the grid end. A low voltage range should be used. The meter can then indicate the voltage drop caused by gas current, and if any is found, the tube is discarded. There is only one hitch in this scheme — a leaky coupling condenser from the previous stage can cause the same kind of positive potential to develop across the grid resistor. So we can do either of two things:

(1) Try a new tube in the socket;

(2) If the new tube is not available, cut the lead to the coupling condenser to see if this eliminates the positive voltage.

Therefore, we should make further checks to pinpoint the trouble. There are several ways to do this: (1) if a new tube is available, we can substitute it for the suspected tube, to see if the positive voltage reading disappears; (2) if a new tube is not on hand, we can observe the, voltmeter reading with the suspected tube re-moved from the socket, provided that the set does not have series-wired filaments; (3) we can cut the lead to the coupling condenser, and note the effect on the voltmeter reading.

If it is necessary to test for gas effect with a 1000-ohms-per-voltmeter in a circuit similar to that shown in Figure 1, a different technique should be used. The set should be put into operation with the voltmeter connected across the cathode resistor (Figure 1). In this position the meter records the voltage drop which is produced mainly by the plate current of the tube. Naturally the amount of voltage found at this point is also affected by gas current flowing in the grid circuit. However, the emission quality of the tube also affects the amount of cathode voltage present, so the best way to check for gas is to observe the meter for any gradual change in voltage that takes place after the initial warm-up period. If the voltage reading increases or decreases as the set continues to operate, this can be taken as an indication that gas ionization is present. However, the possibility of a leaky coupling condenser should be checked by cutting the lead to this condenser, to see if this causes any change in the voltage reading. It should also be kept in mind that a leaky cathode condenser is capable of causing a gradual change in the cathode voltage.

The method described above of checking for positive voltage across a grid resistor can be applied to a variety of amplifier circuits in which the grid resistor has a value of 50,000 ohms or more, and the resistor is not shared by another tube circuit. In cases where a grid resistor is common to two or three tubes, as in automatic-volume-control or automatic-gain-control circuits, the same principle can be applied to determine whether any of the controlled

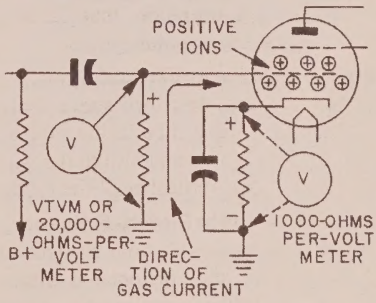


Figure 1 - Method of detecting gas ionization in a stage having high resistance in the grid circuit.

tubes has a gassy condition, but the test will not, of course, indicate directly which tube is at fault. For example, the grid circuits of two i-f amplifiers in an automatic-gain-control circuit may have an isolating resistor (a-g-c filter resistor) that is common to the two tubes, as shown in Figure 2. The check should be made with no receiver input signal, to avoid developing any appreciable a-g-c voltage. The presence of any positive voltage reading indicates gas ionization in one (or both) of the two amplifiers. The tube at fault can be found

eaily by substituting new tubes, one at a time. When making this test, it should be kept in mind that a leaky a-g-c filter condenser ("C" in Figure 2) can cause the same kind of voltage reading as gas ionization of the tubes.

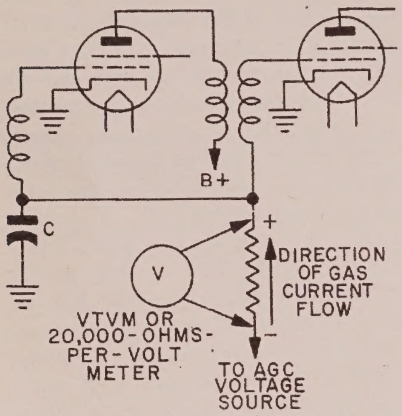


Figure 2 - Method of detecting gas current due to ionization in one or more tubes in a typical a-v-c or a-g-c circuit

R-F oscillators can be checked for gassiness by stopping the oscillations and checking for positive voltage across the grid leak. Figure 3 shows a typical oscillator circuit, and the connections for making this check. If the tank circuit does not carry B + voltage, stop oscillations by connecting a shorting lead (using a short piece of wire) across the tank circuit. If the tank circuit does carry B + voltage, shunt it with a .1-µf. or .25-µf. condenser. Then connect the voltmeter across the grid leak and observe the voltage reading, if any. A positive grid voltage indicates gas ionization. Do not leave the tank circuit shorted out any longer than is necessary, because in most oscillator circuits the tube has no negative grid bias provided when it is not oscillating, and, consequently, the plate current is somewhat higher than normal.

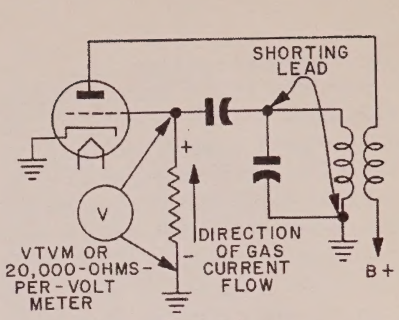


Figure 3

When applying this test to high-frequency oscillators, such as those used in TV, it may be that a tubular paper condenser across the tank circuit will not prevent the oscillator from operating, because this type of condenser may act more like an inductance than a capacitance at high frequencies. If such is the case, the oscillations will be indicated by a negative voltage reading on the voltmeter. To stop the circuit from oscillating, try shunting the tank circuit with a small molded mica condenser such as 250 µµf.

With a little ingenuity, the same principles of testing explained above can be applied to almost any circuit in a radio or TV set. As in all testing, it is advisable to repeat any test wherein a new tube is substituted for an original one. It pays to double-check.

An oddity in this story: it doesn't discuss the effects of gas in a picture tube, which led to odd effects in terms of the brightness and focus. - Ed.

Beyond the scope of this article but insightful: in radios, the two diodes in the detector-AVC-audio tube (12SQ7 et al.) are usually wired in parallel for lack of anything better to do. However, in a few sets the second diode is connected to the AVC line as a "gas gate." This was to prevent the AVC lead, normally negative by a few volts, from swinging positive in the event of a gassy converter or IF-amp tube. Not obvious, but not usually explained! - Ed.

A SIMPLE CATECHISM ON TUBE CHECKERS

Every Dealer Who Values Satisfied Customers and Who Hopes to Increase His Profits through the Practice of Tube Testing Should Know the Answers to These Questions

RCA *Good News*, Oct. 1931, courtesy John Okolowicz

Q. To what demand do we owe the existence of tube checkers?

A. Tube checkers came into existence because of the demand on the part of radio dealers, and particularly service men, for a quick method of determining the ability of tubes to perform in a radio set.

Q. What kinds of tube checkers are there to choose from?

A. Tube checkers vary in kind from the type which will successfully pick out inoperative tubes to the most elaborate and accurate equipment maintained by vacuum tube manufacturers for their own laboratory work.

Q. What should be the basis on which tube checkers are judged?

A. A tube tester should be judged only on the basis of its success in doing what it was designed to do.

Q. Is a simple tube checker just as desirable, from a dealer's point of view, as an elaborate one?

A. A simple tester, which is intended only to pick out worn-out tubes, may be just as good for its job as more elaborate equipment would be for the same job, but its limitations must be recognized.

Q. What fact should the dealer be particularly interested in determining by the use of a tube checker?

A. Radio dealers today are interested first in increasing their tube sales, and consequently, they are particularly interested in determining which tubes brought in by their customers are worn-out.

Q. What is the requirement for a tube tester in this field?

A. The requirement for a tube tester in this field is simply to consistently separate worn-out tubes from good tubes.

Q. What kind of equipment is necessary to do this?

A. This kind of job can be accomplished by means of well-designed equipment relatively simple in form and of reasonable accuracy.

Q. What is the advantage of such simple equipment?

A. Such simple equipment has the virtue of needing little supervision and of giving fair results in inexpert hands.

Q. Can the results of this type of equipment be considered laboratory measurements?

A. In practice, a simple tube checker cannot of itself duplicate conditions which will be representative of every type of set, every kind of tube in operation, and of all actual set operating conditions, so, naturally, the results obtained from such type of equipment can never be considered laboratory measurements.

Q. What is the primary purpose of tube checkers being purchased by dealers today?

A. It must be remembered that the tube checkers that are being purchased today by dealers are primarily intended to give quickly, results indicative of tube performance in a radio set in order to determine whether or not the tubes are worn out.

YOUNG MEN WANTED IN

NAVY RADAR

BE A RADIO TECHNICIAN

- Enlistees and inductees both eligible
- You start as a Seaman First Class
- Ten months of specialized training
- You earn a Petty Officer rating
- One of the war's most exciting fields
- Insures your postwar future

INQUIRE AT NEAREST NAVY RECRUITING STATION